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09/839,941	04/20/2001	Mark Philip D'Evelyn	RD-27,966	4094

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EXAMINER

LOUIE, WAI SING

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 08/01/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .

09/839,941

Applicant(s)

D'EVELYN ET AL.

Examiner

Wai-Sing Louie

Art Unit

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-- The MAILING DATE of this c mmunication appears on the c ver sheet with the correspondence address --

Peri d for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disp sition of Claims

- 4) ☒ Claim(s) 1-123 is/are pending in the application.
- 4a) Of the above claim(s) 50-58 and 107-123 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-49 and 59-106 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Pri rity under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-49 and 59-106, drawn to a semiconductor device, classified in class 257, subclass 184.
- II. Claims 50-58 and 107-114, drawn to a semiconductor substrate, classified in class 257, subclass 103.

The inventions are distinct, each from the other because of the following reasons:

Inventions Group I and Group II are related as combination and subcombination.

Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because the semiconductor structure could be disposed on other substrate. The subcombination has separate utility such as the substrate could be used for a LED device.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Robert Santandrea on 7/1/02 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-49 and 59-106. Affirmation of this election must be made by applicant in replying to this Office action. Claims 50-58 and 107-114 withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 4-5 and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- In claim 4, the claimed invention comprises either “a Schottky contact or an ohmic contact”. However, claim 5 and claim 10 are dependent claims of claim 4,

where claim 5 refers to said Schottky contact without definitively selecting the Schottky contact thus apparently keeping the alternative. It is suggested that the phrase "where the contact is a Schottky contact ..." be added. Similar comments hold for claim 10.

- In claim 10, the claimed invention does not have "an ohmic contact is affixed to one of an n-doped active layer and substrate". For the purpose of examination, "an ohmic contact is affixed to an n-doped layer" is assumed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5, 14, 18-19, 33, 36, 59-62, 71, and 75-76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Tischler et al. (US 5,679,152) and Tanaka et al. (US 6,377,596).

With regard to claims 1 and 59, Chen discloses a Schottky barrier detector (col. 3, line 26 to col. 10, line 34 and fig. 1) comprising:

- At least one active layer 4 comprising AlGa_N deposited on the substrate 1;
- At least one conductive contact 5 structure affixed to at least one active layer 4 and the substrate;

- Chen discloses an active layer 4, but is not a GaN substrate. However, Tischler et al. disclose growing a GaN substrate on a silicon handle substrate, etching the handle substrate away, and depositing the rest of the structure on the GaN substrate (Tischler fig. 2 to 5). Tischler et al. teach growing a GaN substrate may have the effect of pushing the defects into the sacrificial substrate (Tischler col. 4, lines 34-38). Therefore, it would have been obvious at the time the invention was made to have a GaN substrate on Chen's device in order to eliminate the defect on the device. Chen does not disclose the substrate having a dislocation density of 10^5cm^{-2} . However, Tanaka et al. disclose the dislocation density of an GaN substrate grown by the homoepitaxial growth method is in the range of 10^4 to 10^5cm^{-2} (Tanaka col. 20, lines 28-30 and col. 28, lines 5-13). Tanaka et al teach the homoepitaxial growth method to grow an GaN substrate over the handling SiC substrate has a lattice match with the SiC substrate and prevents dislocation formed in the GaN device (Tanaka col. 18, lines 43-46). Therefore, it is obvious the GaN substrate epitaxially grown over a sacrificial substrate has a low dislocation density.

With regard to claims 2-3, and 60, Chen discloses an AlGaIn active layer 4 in the structure (col. 3, line 41).

With regard to claims 4 and 61, Chen discloses the structure comprises a Schottky contact 5 and an ohmic contact 6 (col. 3, line 44).

With regard to claims 5, 14, 62, 71, Chen discloses the Schottky contact comprises palladium (col. 4, line 14).

With regard to claims 18-19, 75-76, these claims contain process limitations, which carry no patentable weight in claims drawn to a device.

With regard to claims 33, 90, Chen discloses at least one active layer comprises an insulating layer 4 disposed on a surface of the substrate 1, where the conductive contact structure comprises at least one Schottky contact affixed to the active (insulating) layer 4 and at least one ohmic contact affixed to the first n-doped layer 3.

With regard to claims 36 and 93, the first n-doped layer 3 has a thickness about 0.5 to 1.5 μm (col. 4, line 2).

Claims 6-13, 15-17, 20-22, 63-70, 72-74, 77-79, and 107 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Soares (US 6,034,404).

With regard to claims 6, 15, 63, 72, Chen discloses a Schottky contact 5, but does not disclose the Schottky contact comprises nickel and gold. However, Soares discloses a Schottky contact on a semiconductor sensor comprises a double layers 120 and 130 made of nickel and gold (Soares col. 7, lines 16-30). Soares teaches the Schottky contact have a fast response time and lower operating voltage (Soares col. 2, lines 47-49). Therefore, it would have been obvious at the time the invention was made to provide a nickel and gold on Chen's Schottky contact. Doing so would have a fast response time and lower operating voltage device.

With regard to claims 7-8, 64-65, Chen discloses the Schottky contact 5 is contacted to the active layer 4. Chen modified by Soares discloses the contact layer 120 comprises nickel (Soares col. 7, line 20) and the contact layer 130 has a gold rich composition (Soares col. 7, line 21).

With regard to claims 9, 66, Chen discloses the Schottky contact has a thickness of between 2 to 5 nm (col. 4, line 15).

With regard to claims 10-13, 67-70, Chen discloses the ohmic contact is affixed to an n-doped active layer where the ohmic contact comprises titanium and aluminum (col. 4, lines 16-17). Chen does not disclose any titanium-rich or aluminum-rich compositions. However, one with ordinary skill in the art would vary the alloy composition to achieve the lowest resistance across the contact in order to meet the operating threshold voltage. Therefore, it is obvious to have the titanium-rich or aluminum-rich compositions as routine optimization.

With regard to claim 16-17, 73-74, Chen and Soares do not disclose an ohmic contact comprises of gold and nickel, nickel and nickel-rich composition, and gold and gold-rich composition. However, Soares teaches it is known in the art of semiconductor technique that when a highly doped semiconductor is brought into contact with a metal forms an ohmic contact (Soares col. 2, lines 43-59). Therefore, it would have been obvious at the time the invention was made to bring gold and nickel, nickel and nickel-rich composition, and gold and gold-rich composition into contact with n+ layer 3 in Chen's device in order to form an ohmic contact.

With regard to claims 20, 77, Chen does not disclose the resistivity across the active layer and the metal contact. However, Chen modified by Soares in claim 6 above, disclose the resistivity is about 2.45 to 3.55 micro-ohm-cm (Soares col. 2, line 1).

With regard to claims 21-22, 78-79, Chen discloses the insulating layer 3 has a thickness of 1.2 μm (col. 4, line 3) having a doping concentration of $3 \times 10^{18} \text{ cm}^{-3}$ (col. 4, line 45).

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Claims 23-32, 34-35, 37-44, 80-92, and 94-101 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Müeller et al. (US 4,902,136) and Gerner et al. (US 5,698,865).

With regard to claims 23-26, 80-83, Chen discloses the active layer 4 is deposited on the insulating layer 3 and the insulating layer 3 is deposited on the substrate 1 (fig. 1), but Chen does not disclose a plurality of Schottky contacts on the active layer. However, Müeller et al. disclose a second Schottky contact (Müeller col. 6, line 14). Müeller et al. teach the second Schottky contact allows to set up a parallel structure within the device (Müeller col. 6, lines 22-29). Therefore, it would have been obvious to one with ordinary skill in the art to provide a plurality of Schottky contacts in order to set up a parallel structure within the device. Chen discloses the active (insulating) layer is undoped (col. 3 line 43). Chen discloses an n-doped layer 3 is deposited between the substrate 1 and active (insulating) layer 4 (fig. 1b).

With regard to claims 27, 84, Chen discloses the n-doped layer is n-GaN (col. 3, lines 43-45).

With regard to claims 28, 34, 85, 91, Chen discloses the semiconductor device, where:

- An active layer 4 is deposited on the substrate 1, but the substrate is undoped.

However, Gerner et al. disclose the substrate is n-doped. Gerner et al. teach the current can be distributed evenly through the device (Gerner col. 2, lines 1-16).

Therefore, it would have been obvious to one with ordinary skill in the art to provide an n-doped substrate in order to spread the current throughout the structure.

- A first p-doped layer 5 is deposited on a surface opposite the n-doped substrate (Gerner fig. 4), where the first ohmic contact 7 affixed the first p-doped layer 5 and a second ohmic contact 10 affixed to the n-doped substrate 1 (Gerner fig. 4).

With regard to claims 29, 86, Chen modified by Gerner et al. would disclose a p-doped layer 6 deposited on a surface of the first p-doped layer opposite the active (insulating) layer 4 (Gerner fig. 4).

With regard to claims 30, 87, Chen modified by Gerner et al. do not disclose the second p-doped layer 6 is p-doped GaN. However, Chen discloses the entire structure is GaN (col. 3, lines 44-45). Therefore, it is obvious the second p-doped layer is GaN.

With regard to claims 31, 88, Chen discloses the active layer has a thickness of 0.3-1.5 μm (col. 4, lines 7-8), but does not disclose the thickness of the first p-doped layer. Since the applicant has not established the criticality of the thickness stated and since the thickness is in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use the value in the device of the thickness. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

With regard to claims 32, 35, 89, 92, Chen, modified by Tischler et al. in claim 1, would disclose the n-doped layer 3 is disposed between the n-GaN substrate 1 and the active (insulating) layer 4 (fig. 1).

With regard to claims 37-39, 94-96, Chen does not disclose a second n-doped layer disposed between the substrate and first n-doped layer. However, Gerner et al. disclose an n-

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doped substrate 1 and the first n-doped layer 3 (Gerner fig. 4). Therefore, it is obvious that the buffer layer 2 is an n-doped layer (Gerner fig. 4). Since Chen discloses the entire structure is GaN (col. 3, lines 44-45), the second n-doped layer 2 would have been GaN. Chen discloses the thickness of the layer 2 is 10-50 nm (col. 3, line 63).

With regard to claims 40-41, 43, 97-98, 100, Chen discloses the dopant is silicon (col. 4, line 49).

With regard to claims 42, 99, Chen discloses the substrate and active layer is epitaxially deposited (col. 3, line 60).

With regard to claim 44, 101, Chen modified by Gerner et al. do not disclose a p-type dopant. However, it is obvious to reverse the dopant types.

Claims 45-49 and 102-106 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 6,104,074) in view of Saito et al. (US 6,121,634).

With regard to claims 45, 102, Chen does not disclose a p-type dopant. However, it is common to reverse the dopant types in a device and Saito et al. disclose a p-type dopant is magnesium (Saito col. 8, line 21). Therefore, it is obvious to use magnesium as a p-type dopant.

With regard to claims 46, 103, Chen disclose the substrate and active layer is epitaxially deposited (col. 3, line 60).

With regard to claim 47, 104, Chen does not disclose the at least one p-type dopant is implanted in the substrate. However, in the device claims "implant step" carries no patentable weight.

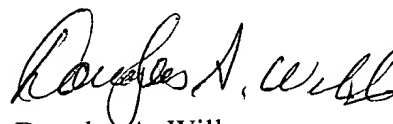
With regard to claims 48-49, 105-106, it would be obvious to apply the detector to any detection application.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

wsl
July 29, 2002


Douglas A. Wille
Patent Examiner